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TITLE: Observing System Simulations for the NASA ASCENDS Lidar CO₂ Mission
Concept: Substantiating Science Measurement Requirements

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ABSTRACT BODY: The NASA ASCENDS mission (Active Sensing of Carbon Emissions, Nights, Days, and Seasons) is envisioned as the next generation of dedicated, space-based CO₂ observing systems, currently planned for launch in about the year 2022. Recommended by the US National Academy of Sciences Decadal Survey, active (lidar) sensing of CO₂ from space has several potentially significant advantages, in comparison to current and planned passive CO₂ instruments, that promise to advance CO₂ measurement capability and carbon cycle understanding into the next decade. Assessment and testing of possible lidar instrument technologies indicates that such sensors are more than feasible, however, the measurement precision and accuracy requirements remain at unprecedented levels of stringency. It is, therefore, important to quantitatively and consistently evaluate the measurement capabilities and requirements for the prospective active system in the context of advancing our knowledge of carbon flux distributions and their dependence on underlying physical processes. This amounts to establishing minimum requirements for precision, relative accuracy, spatial/temporal coverage and resolution, vertical information content, interferences, and possibly the tradeoffs among these parameters, while at the same time framing a mission that can be implemented within a constrained budget.

Here, we present results of observing system simulation studies, commissioned by the ASCENDS Science Requirements Definition Team, for a range of possible mission implementation options that are intended to substantiate science measurement requirements for a laser-based CO₂ space instrument.

To this end, we have assembled a relatively complete description of the prospective mission sampling, atmospheric, and surface states that enables us to quantitatively scale measurement errors globally for a variety of nominal CO₂ instrument approaches. The resulting error distributions are used in inverse studies to estimate the impact of the laser observations on surface flux estimation. Both random and bias error scenarios are tested and these are used in a variety of inverse model frameworks in hopes of reducing the dependence of the results on model specifics. Sensitivity to key design

variables is explored and quantified. The results indicate that within reasonable technological assumptions for the system performance, high measurement quality and quantity can be obtained that will fulfill the nominal ASCENDS objectives and provide substantial improvement in our knowledge of global carbon cycle processes.

INDEX TERMS: [0365] ATMOSPHERIC COMPOSITION AND STRUCTURE / Troposphere: composition and chemistry, [0322] ATMOSPHERIC COMPOSITION AND STRUCTURE / Constituent sources and sinks, [0394] ATMOSPHERIC COMPOSITION AND STRUCTURE / Instruments and techniques, [0428] BIOGEOSCIENCES / Carbon cycling.

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Additional Details

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